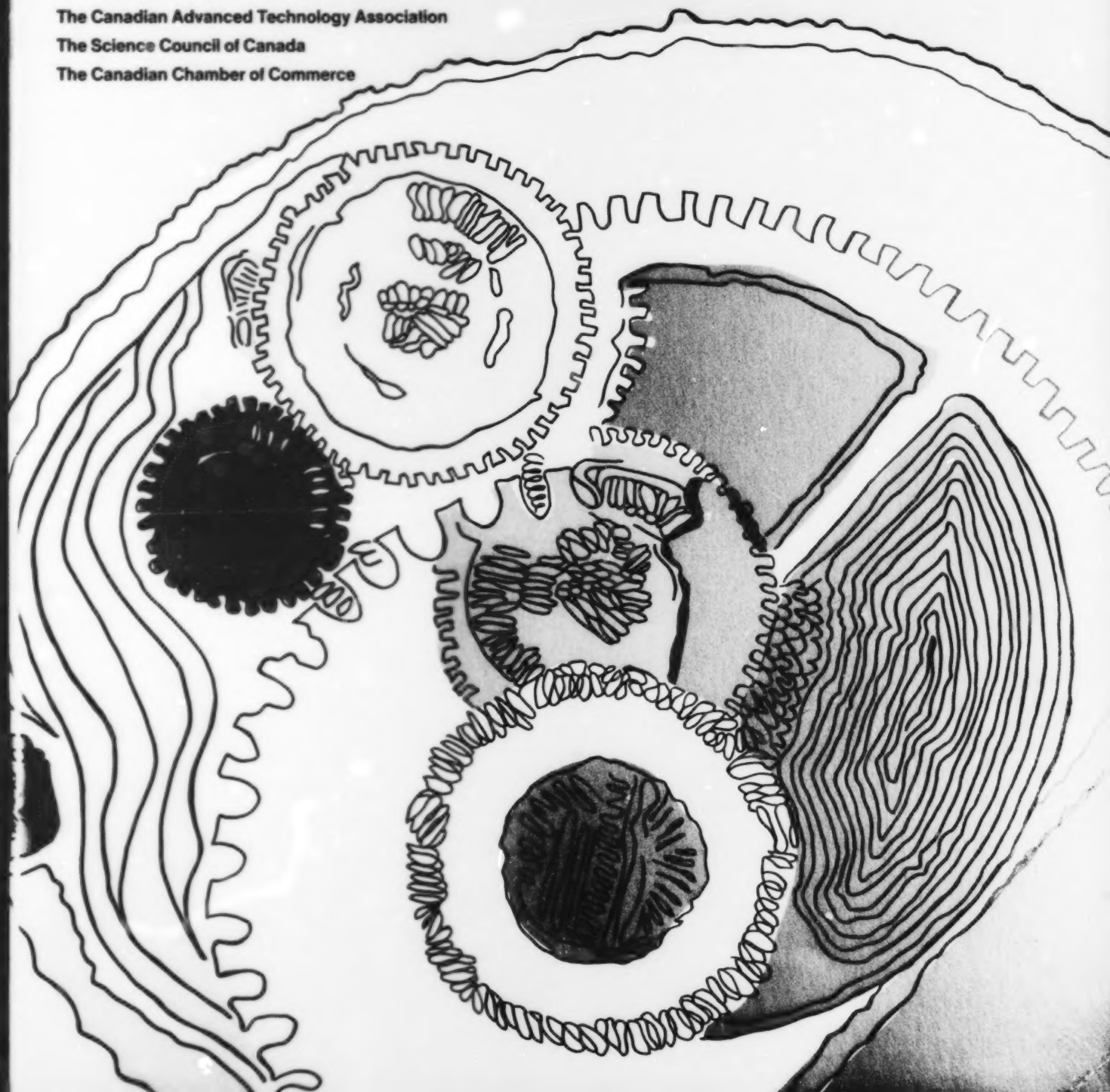
GRASSROOTS INITIATIVES, GLOBAL SUCCESS

Report of the 1989 National
Technology Policy Roundtable

The Canadian Advanced Technology Association
The Science Council of Canada
The Canadian Chamber of Commerce



GRASSROOTS INITIATIVES, GLOBAL SUCCESS

Report of the 1989 National
Technology Policy Roundtable

The Canadian Advanced Technology Association

The Science Council of Canada

The Canadian Chamber of Commerce

July 1990

90-06573/

This report is a joint publication of the Canadian Advanced Technology Association, the Science Council of Canada and the Canadian Chamber of Commerce. Drafting was coordinated by Charles Davis, a science adviser at the Science Council.

The views contained in this document are not necessarily those of the three sponsoring organizations.

July 1990

Science Council of Canada
100 Metcalfe Street
Ottawa, Canada
K1P 5M1

Canadian Advanced Technology Association
275 Slater Street, Suite 803
Ottawa, Canada
K1P 5H9

Canadian Chamber of Commerce
55 Metcalfe Street, Suite 1160
Ottawa, Canada
K1P 6N4

Cat. No. SS31-18/1989E
ISBN 0-662-17952-8

© Ministry of Supply and Services, 1990

Table of Contents

Preface **5**

Chapter 1. The Competitive Challenge Facing Canadian Communities **7**

A. Communities and the New Geography of Competition 7

B. The Community Technology Engine 8

C. Innovative Communities and National Action: Preparing for the 21st Century 12

Chapter 2. Vision and Culture **14**

A. Extending Science and Technology Networks into the Community 14

B. Science and Technology in the Economic Development Planning Process 15

Chapter 3. Building and Using the Community Knowledge Base **18**

A. Building the Knowledge Base 18

B. Using the Knowledge Base 20

Chapter 4. Growing Advanced-Technology Companies **22**

A. Financing Advanced-Technology Enterprise 22

B. Nurturing Growth: Management Support for Early-Stage Companies and Entrepreneurs 24

C. Advanced-Technology Support Infrastructure 24

D. Market Development 25

Chapter 5. Applying and Using Technology to Build Competitive Strength **26**

A. Executive and Management Awareness 26

B. Evaluating Company-Specific Technology Needs 27

C. Developing and Accessing Technology 27

D. Education and Training 28

Chapter 6. Pulling Together: Action for National and Regional Players **31**

A. Education, Training and Skill Upgrading Needs of the Knowledge-Based Economy 32

B. Enhancing the Climate for Innovation 33

C. Encouraging the Application and Use of Technology 36

D. Regional Development Policies 36

E. The Communications Infrastructure of the Information Age 37

F. Sustaining Political Commitment: The Management of Change 38

Chapter 7. Conclusion **39**

Preface

In 1989, the Science Council of Canada, the Canadian Advanced Technology Association and the Canadian Chamber of Commerce joined forces to sponsor the National Technology Policy Roundtable on the theme of the "Technology Engine in Community Economic Development."

Public participation in the roundtable process was extensive. First, several hundred people shared their views during a written consultation period in the spring and summer of 1989. About 800 people participated in the locally-organized workshops that were held in Victoria, Edmonton, Saskatoon, Winnipeg, Kitchener-Waterloo-Guelph-Cambridge, Toronto, Ottawa, Montreal, Quebec, and Halifax. Finally, about 150 people attended the Roundtable itself in Toronto in October 1989.

This report attempts to reflect a general consensus viewpoint of the Roundtable participants. On some questions, no clear consensus emerges. However, Canadians agree on many issues: in particular, the importance of community-level initiatives to nurture and apply science and technology for economic development.

We realize that we have not exhausted the question of how grassroots technology strategies might best be generated and applied. We are optimistic, however, that as increasing numbers of Canadian community leaders come to appreciate the scope that exists for business development through science and technology, communities will be eager to share their experiences and to learn from the experiences of others.

This report is addressed to community leaders across Canada. We believe that the potential for further local initiative is considerable, and we hope that this report will strengthen the efforts of those in Canadian communities who are working to make things happen and encourage others to get started. We hope that community leaders will discuss this report and share it with others.

This report does not necessarily represent the official points of view of the Science Council of Canada, the Canadian Advanced Technology Association, or the Canadian Chamber of Commerce.

CHAPTER 1

The Competitive Challenge Facing Canadian Communities

This report is about competing in the new "high-tech" global economy.

Specifically, it is about the role Canadian communities must play in ensuring Canada's long-term competitive strength.

It is about creating wealth and jobs and maintaining Canada's standard of living by "gearing up the technology engine" at the community level.

Its premise is that the success with which Canadian communities adjust to the new economic era will determine Canada's ability to prosper in the 1990s and beyond.

A. Communities and the New Geography of Competition

The emergence of the global marketplace has precipitated the arrival of a new economic era. In our changing world economy, the rise or fall of national economies and of individual industries and companies will be largely determined by how effectively they manage technology-driven change.

In the new era, scientific capability and technological skills will play at least as important a role as natural resources and good locations in determining investment decisions and local economic growth. Community competitiveness will depend on knowledge, a wholly portable asset which, unlike traditional factors conditioning community competitiveness, resides in people and hence can migrate anywhere.

To be competitive, individual communities must attract and hold highly skilled people, build advanced-technology industries and help already established industries to make better use of technology.

Today, the most dynamic national economies are focused around communities which actively encourage the emergence and growth of advanced-technology and research-intensive firms, and promote the rapid diffusion of innovative technology to established firms.

Japan's economic might resides primarily in Tokyo and several other cities. U.S. technological strength is concentrated in some 30 metropolitan regions including Palo Alto (Silicon Valley) and Boston (Route 128). Nearly 40 per cent of West Germany's R&D occurs within 100 kilometres of Frankfurt. Italy's high-tech industry is concentrated in several northern metropolitan regions. In the emerging Pacific Rim economies, Seoul, Hong Kong and Singapore are the technological centres.

While culturally distinct, these communities have in common tremendous scientific and technological capabilities as well as enormous pools of appropriately skilled people: scientific and technical personnel; technological entrepreneurs; experienced managers; and venture capitalists — who have the knowledge and vision to translate scientific advances into business opportunities.

By "community," we mean localities in which people live and interact, and toward which people feel a sense of belonging. A community therefore has an important subjective dimension. Several neighbouring cities may consider themselves to be part of the same community. On the other hand, a large city may lack a sense of community. Much depends on how active and organized the lines of communication are among key players at the community level.

Communities must be central players in innovation. They are the environments in which most business people make decisions. Peoples' attitudes about science, technology, and business form in a community context. Communities are where leadership emerges, and where personal relationships foster the transmission of new skills. It is within a community setting that technology, people and resources come together to create new enterprise and generate economic development.

Summing up, the future competitiveness of Canadian communities will depend, first, on the knowledge and skills of their people; second, on the growth of technology-based industry and on the diffusion of technology within established industry; and third, on the manner in which communities are linked to broader national and global pools of scientific and technological capability and markets.

Canadian communities that respond creatively to meet these new challenges have much to gain. Communities that lack the capacity to become more technologically innovative have much to lose.

B. The Community Technology Engine

The notion that every community should build its own "technology engine" in order to respond quickly and efficiently to new growth opportunities emerged very strongly from the Roundtable discussions.

Roundtable participants identified four components that must be present for a technology engine to function. How effectively the engine runs depends ultimately on the quality of each component and the extent to which different components work in harmony.

The four components are as follows:

- the knowledge that exists within science and technology institutions and the quality of links between the S&T infrastructure and industry;
- the infrastructure and networks that encourage the application and use of technology throughout all segments of a community's industrial base;
- the support framework available for advanced-technology industry. This includes the S&T infrastructure, the human resource base and specialized services;
- community vision and culture that encourages and recognizes scientific, technical and business endeavours.

The operation of the engine is depicted in Figure A.

The four components of the community technology engine give rise to four strategic goals around which a community's economic development planning efforts might be organized.

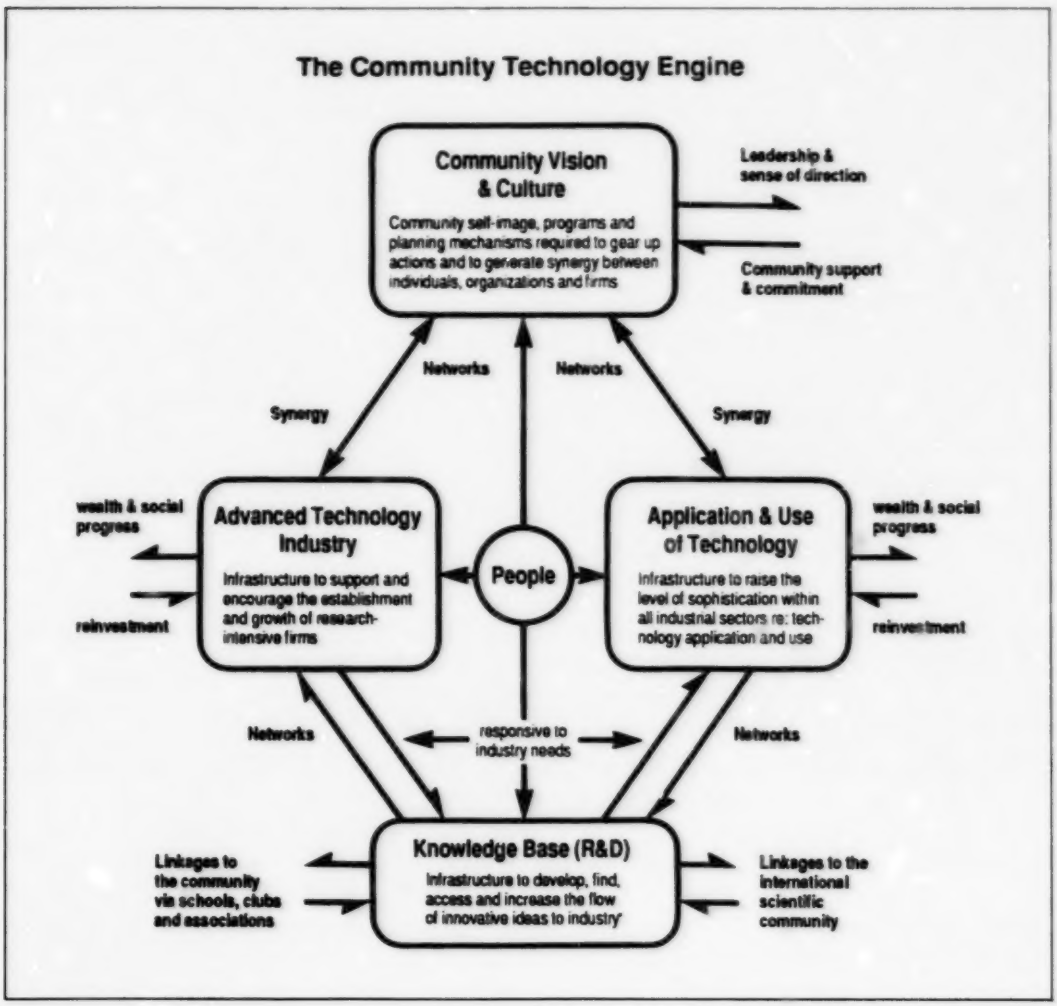

The Community Technology Engine
Community Vision & Culture
Community self-image, programs and planning mechanisms required to gear up actions and to generate synergy between individuals, organizations and firms
Leadership & sense of direction
Community support & commitment
Networks
Networks
Synergy
Synergy
wealth & social progress
reinvestment
Advanced Technology Industry
Infrastructure to support and encourage the establishment and growth of research-intensive firms
People
Application & Use of Technology
Infrastructure to raise the level of sophistication within all industrial sectors re: technology application and use
wealth & social progress
reinvestment
Networks
responsive to industry needs
Networks
Linkages to the community via schools, clubs and associations
Knowledge Base (R&D)
Infrastructure to develop, find, access and increase the flow of innovative ideas to industry
Linkages to the international scientific community

Figure A

Vision and Culture

GOAL: To foster within a community a social and cultural environment in which people value science, technology and entrepreneurship.

To realize the full growth potential of a community technology engine, it is essential to stimulate the growth of each component. By working together, components produce effects which are greater than the combined effects of each component working alone. To achieve maximum synergy, communities must plan and organize.

The ability of communities to create synergy depends on the image they project and their vision of the future. Some communities have become well known in a relatively short time for their technological dynamism. Other communities whose image does not reflect a commitment to science and technology are generally overlooked by innovative business. Communities must foster a genuine commitment to science, technology and business, and they must project this commitment within and outside the community.

The Knowledge Base

GOAL: To expand a community's scientific, technological and research infrastructure and to increase the industrial use of that infrastructure.

A research base is the soil in which advanced technology companies take root and grow. It is the source of both the knowledge and the people that fuel the innovation process. It can provide solutions to problems of corporate productivity, product quality and price competitiveness.

A community's R&D infrastructure includes science and technology-oriented people in research universities, technical schools, small technology-intensive firms and public sector laboratories. Large firms with vigorous R&D programs also make a valuable contribution to a community's pool of human resources and knowledge. Frequently, small entrepreneurial firms spin out from the technology development activities of leading firms. These smaller firms, in turn, can be important channels for the diffusion of technology and skills throughout the community.

To be effective in the economic development process, a community's scientific and technological infrastructure must be attentive to local industry's needs. Universities and public laboratories must address the needs of all industries within the community, from the high-technology industries to traditional industries that are learning how to use improved technology. Industry, for its part, must learn about local research, development, financial and commercial opportunities. It must also find out what capabilities exist within the local scientific community.

The Advanced-Technology Industry Base

GOAL: To nurture advanced-technology companies in the community and to help them be internationally-competitive firms.

Advanced-technology firms flourish in specific environments. They need specific kinds of technical, financial, managerial and labour resources. Consequently, the process of expanding a community's base of advanced-technology enterprise presents a unique set of challenges.

First of all, technological development is a highly people-intensive process. Entrepreneurship is crucial. Second, early-stage companies are usually involved in product development for a number of years before they enter the marketplace. This is why start-up firms have a persistent need for large amounts of so-called "patient capital." Many start-up companies must be nurtured during early growth stages, as they are predominantly driven by pure research rather than by potential commercial opportunities.

Once a firm has made it through the start-up stage, the global nature of the marketplace makes subsequent growth difficult. International marketing adds enormously to the management and financing challenges facing these companies.

Advanced-technology firms are also highly dependent on the availability of specialized management, financing, infrastructure and market development.

Applying and Using Technology in All Sectors

GOAL: To create a climate and provide services that will enable firms in all sectors to improve their ability to select and use technology competitively.

Technology diffusion services are an important component of the technology engine. They serve to support the use of technology by all industrial sectors.

The role of technology in creating competitive strength is steadily increasing today. Figure B illustrates the declining importance of the cost of labour in relation to the cost of capital (i.e., shop-floor production technology) and the management of overheads (i.e., the use of technology to facilitate interaction with customers, the automation of office functions and the control of inventories).

In highly automated operations, labour's share of direct manufacturing costs is now rarely more than 10 per cent. Productivity gains, product quality, and cost

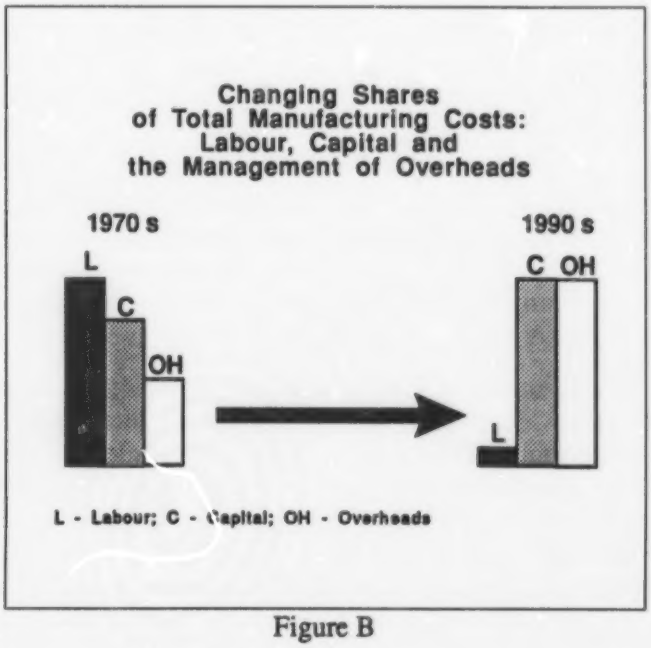


Figure B

competitiveness increasingly derive from the application, use and management of technology. Similar tendencies are clear in the service sectors.

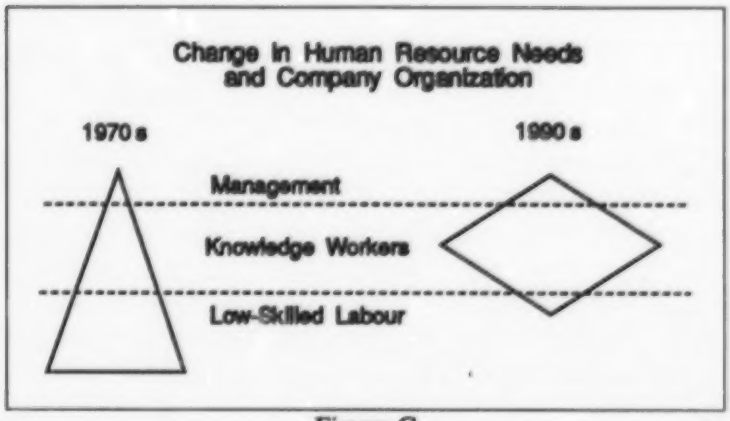


Figure C

The strategic importance of an appropriately skilled and motivated workforce is therefore increasing. The growing capital intensity and higher skill levels require significant changes in the structure and management of companies (see Figure C).

In traditional pyramid-structured organizations, supervisors could train lower-ranked jobs in half a day. Today's more innovative firms are moving away from the pyramid in favour of flatter organizational models as the role of knowledge workers becomes increasingly important. In the modern organization, the skill and knowledge gap between senior management and workers is shrinking.

Communities can play an important part in increasing the technological sophistication of all their industries. They can raise corporate awareness of technology and thereby motivate leadership within companies. They can improve access to technological information and encourage management and labour adjustment through training. They can also create human resource pools and networks to promote technological innovation.

C. Innovative Communities and National Action: Preparing for the 21st Century

Advanced-technology centres frequently exhibit a phenomenon known as critical mass. At some point in their development, enough people become involved in innovative activities for the activities to become self-sustaining. The accumulated knowledge base of the community feeds the process of commercializing new technologies, products and services. A process of sustained growth takes over.

Most of North America's well-known technological regions (such as Silicon Valley and Route 128) have large concentrations of resources. No consensus exists yet concerning what resource threshold must be reached in order to achieve critical mass. Some knowledgeable industry executives say communities need a minimum of 20,000 employees in advanced-technology enterprise to become self-sustaining. Others say a community needs at least 300 high-tech firms. They put the threshold number of scientists and engineers at 2,000. Whatever the size, all communities can enhance their

economic strength by developing initiatives to promote and diffuse technological capability.

Globalization of economic activity reinforces the importance of critical mass and makes the task of building it even more difficult. It increases the threshold costs of conducting basic and applied industrial research, for example.

Until a community has achieved a respectable level of technological activity, its industrial base will have problems attracting people with the education, training and ambition to pursue advanced-technology careers. Such communities experience difficulty holding skilled people when companies fail or layoffs occur during economic downturns.

Many practical, intangible and qualitative aspects of technological development are best nurtured at the community level by people who care deeply about their physical and social environment. The "can do" entrepreneurial spirit present in many Canadian communities is an important part of the solution. We must also find ways to link technologically dynamic regions with each other and with those that need access to innovations. Local resources must be supplemented by access to broader national pools of knowledge, finance and human resources.

There is a pressing need to develop national support networks which supplement community efforts. Canada must do everything possible to help communities pull together. The goal must be to foster the development of a national innovation system which reaches out into the entire business community from one end of the country to the other. The national innovation system must encourage local initiatives that help communities build on their strengths, and it must unite community resources and effort in a common cause.

CHAPTER 2
Vision and Culture

GOAL: To foster within a community a social and cultural environment in which people value science, technology and entrepreneurship.

Attitudes and values are what define a scientific and technological culture. In a community that promotes such a culture, young people are excited by science and technology as are their teachers. Community members are receptive to the challenge of innovation and willing to adjust to technological change.

Vision is the ability to instil a sense of common purpose about a community's potential. It includes the ability to create consensus on how a community should realize its potential.

Roundtable participants agreed that both culture and vision are key characteristics of innovative communities. The development of each requires sustained community efforts over the long term.

A. Extending Science and Technology Networks into the Community

OBJECTIVE: To increase a community's support for and appreciation of the place of science and technology in the local culture.

RATIONALE: Communities can do a lot to encourage scientific and technological creativity. Yet few have even begun to explore this dimension of economic development strategy. Only a few communities have organizations or groups with specific responsibilities for encouraging the adoption of science and technology. Few individuals or groups are aware of the range of activities required to build a community's science and technology culture. Resources and efforts tend to be widely dispersed.

A science and technology-oriented culture will not emerge on its own in most communities. There is a need to plan, organize and promote. Communities should commit themselves to the achievement of scientific and technological goals. To do this, they need to extend science and technology networks into the broader business and political communities.

POSSIBLE COMMUNITY ACTION:

- Bring industry into the classroom. Have local businesses participate in "adopt-a-school" programs at the primary and secondary levels.
- Encourage local firms and business associations to sponsor events such as science fairs, scholarship competitions, science and technology clubs, and scientific and technical classes.
- Encourage museums, libraries and other public institutions to mount scientific and technological exhibits.
- Organize annual "industry open house days" or "high-technology industry tours" to expose the community to advanced-technology enterprise and activities.

B. Science and Technology in the Economic Development Planning Process

OBJECTIVE: To integrate science and technology considerations into the community economic planning process.

RATIONALE: Today, community economic development planners focus primarily on physical infrastructure and attracting investment. Plans to expand a community's advanced-technology base typically focus on the creation of industrial parks.

Communities must also promote scientific and cultural values and translate these values into a vision of what the community wishes to become. Action plans are necessary to make the vision a reality.

Roundtable participants concluded that individual communities have to accept greater responsibility for ensuring their economic future. They will have to find creative ways to access and use technologies to build on local strengths.

Local leadership groups can play key roles in the generation of community vision. They can mobilize community support and build consensus based on priorities. They can help create the proper environment for science and technology-based growth. They can help identify goals and targets for concerted action. They can also help foster communications between industry, government, the education system and the community at large.

Most Canadian communities must learn to incorporate science and technology considerations into their economic development planning processes. The following four planning guidelines provide recommendations for action.

i) Involve the Right Players in the Planning Process

Individuals who are knowledgeable about science, technology and industry should participate in the community development planning process. Suitable candidates include directors of private and public labs and technology centres, corporate planners in technology-intensive firms, industrial development and technology transfer officers,

experienced entrepreneurs, teachers, leaders of industry associations, and federal and provincial government officials.

POSSIBLE COMMUNITY ACTION:

- Establish a science and technology group as part of the development planning process, and make sure the group includes individuals representing scientific, technological and business interests.
- Establish a permanent community forum to provide leadership on S&T issues. The Edmonton Council on Advanced Technology is a useful model.
- Assign a city counsellor the responsibility for science and technology issues.

ii) Build on Local Strengths

The community economic development planning process should begin with an understanding of local strengths and weaknesses. Communities should address their weaknesses as well as their opportunities. The quality of a community's S&T environment makes it a more attractive place for growth-oriented businesses.

Many communities must change their way of thinking about economic development. They should not focus on providing incentives to attract firms from outside. By and large, communities cannot relocate advanced-technology industry this way. Instead, they should cultivate advanced-technology industry indirectly by providing a well-developed scientific and technological infrastructure, leadership and community vision.

POSSIBLE COMMUNITY ACTION:

- Assess community strengths and weaknesses in relation to the four components of the technology engine: culture and vision, the knowledge base, advanced-technology firms, and widespread application and use of technology.
- Set specific objectives to build on strengths and redress areas of weakness.

iii) Time Frames for Success

Science and technology-based industrial strength does not appear overnight. Explosive growth can occur within a decade, but it takes much longer to generate critical mass. It also takes time to enrich a community's technological infrastructure.

Consequently, a long-term commitment is necessary to achieve community science and technology goals and objectives. Communities should not regard the planning process as a "one-time" exercise.

POSSIBLE COMMUNITY ACTION:

- Include science and technology in the community economic development planning process and review progress annually with respect to objectives.

iv) Communicating the Long-Term Vision

A community cannot achieve its long-term science and technology goals without public support. This support in turn depends on public awareness of community goals. The planning process must therefore include efforts to communicate scientific and technical goals to schools, universities, business associations, the financial community, labour groups and the public at large.

POSSIBLE COMMUNITY ACTION:

- Develop and regularly update an integrated communications plan to encourage and maintain public awareness, understanding and support for the community's science and technology goals.

CHAPTER 3
Building and Using the Community Knowledge Base

GOAL: To expand a community's scientific, technological and research infrastructure and to increase the industrial use of that infrastructure.

It is not enough for communities to create a broad base of scientific and technical knowledge within their research infrastructure. They must also make sure the knowledge base is accessible to users and responsive to their needs.

All Canadian communities, regardless of their size, location, or economic base, should improve their ability to use technology. The following discussion considers the steps required to build the knowledge base and to encourage its use.

A. Building the Knowledge Base

i) The R&D Infrastructure

OBJECTIVE: To increase investment in the community R&D infrastructure. Communities may wish to set specific targets, such as pledging to increase investment by 15 per cent per year for the next five years.

RATIONALE: Communities can take initiatives to enhance the growth of their science and technology infrastructure. Communities in the United States, for example, have created pools of investment capital to support local R&D. Some communities issue municipal R&D bonds or grant tax exemptions to R&D facilities. Others mobilize strictly private-sector pools of funds. Some have successfully leveraged external funds to support local R&D.

POSSIBLE COMMUNITY ACTION:

- Provide specific incentives for R&D undertaken within the municipality.
- In negotiating greenfield investments, seek to have companies transfer R&D activity as well as production.

ii) Focusing Community R&D Effort

OBJECTIVE: To focus community efforts on developing R&D infrastructure in areas of strategic local importance.

RATIONALE: The larger the community, the more diversified the research effort that it can develop to competitive levels. Smaller communities, which cannot hope to develop across-the-board competitive R&D infrastructures, may be better off focusing their research efforts.

Some Canadian communities have taken steps to develop local capabilities in critical areas of science and technology. For example, the Ottawa-Carleton Research Institute, a chartered, non-profit research cooperative, involves educational institutions, government and industry players in initiatives to expand collaborative R&D in the region.

POSSIBLE COMMUNITY ACTION:

- Draw up an inventory of local research capabilities and decide which specific research areas to focus on.
- Establish a local organization jointly funded by industry, university and public partners to promote R&D and training. The Ottawa-Carleton Research Institute is an example.
- Establish community-based research networks to link local research to broader national and international activities.
- Establish chairs in local universities in areas of strategic interest to local industry.

iii) National and International Communication Networks

OBJECTIVE: To enhance a community's ability to access broader pools of knowledge.

RATIONALE: High-speed national communication networks for research and development are already in place in most developed countries. The best examples are in the United States, West Germany, France and Japan. In Canada, the National Research Council is assisting with the implementation of an intermediate-speed network.

A communications infrastructure is essential to link Canadian communities with national and international research. A competitive, versatile communications capability is essential if communities hope to participate in collaborative research.

POSSIBLE COMMUNITY ACTION:

- Support the introduction of a national high-speed network for R&D and make sure that community R&D interests have access to the network.

iv) Attracting and Retaining Research Personnel

OBJECTIVE: To increase the number of scientists and engineers in the community. Communities may wish to adopt specific targets — for instance, doubling the number of scientists and engineers in five years — in order to focus initiatives and maintain momentum.

RATIONALE: Several Canadian communities have reported difficulty in attracting or retaining highly skilled research personnel. This problem will probably become more acute as competition increases and shortages of highly-skilled people become more widespread.

The quality of research facilities and networks are important. Communities that successfully develop, attract or retain senior research personnel also tend to be ones that provide superior cultural amenities.

POSSIBLE COMMUNITY ACTION:

- Emphasize community amenities and cultural activities in economic development planning.

B. Using the Knowledge Base

Communities should promote the effective use of their knowledge base by local industry. This challenge encompasses two related aspects: meeting the knowledge needs of industry and transferring technology to industry.

i) Meeting the Knowledge Needs of Industry

OBJECTIVE: To strengthen the links between a community's knowledge base and local industry.

RATIONALE: Most private sector firms can benefit greatly from contact with educational institutions.

Industry researchers usually have highly focused areas of expertise. Moreover, the time available for conducting industrial research is usually relatively short. Even advanced-technology firms need to commercialize their R&D results quickly, generally within a year of the launch of individual research projects. Consequently, these firms have limited interest in conducting basic research and only a limited in-house knowledge of broader scientific and technological developments.

At the same time, most small and medium-sized companies in traditional economic sectors often have weak in-house technical expertise. The process of technological upgrading usually begins when they acquire their first engineering or technical personnel.

Both advanced-technology firms and businesses in traditional sectors therefore stand to gain from the longer-term research carried out in university and government labs, and from the broader knowledge base and educational possibilities within these organizations.

POSSIBLE COMMUNITY ACTION:

- Target university and government research on identifiable industry needs.
- Strengthen local National Research Council (NRC) Industrial Research Assistance Program (IRAP) networks to increase awareness of the knowledge-based resources available within the community.
- Encourage the local university, community college or secondary school to offer knowledge-upgrading programs for the scientific and technical personnel in local firms.
- Organize industry tours of local research labs.
- Promote the exchange of knowledge between researchers and industry. For example, try sponsoring monthly luncheons with guest speakers.

ii) Transferring Technology to Industry

OBJECTIVE: To strengthen the community infrastructure for transferring technology from universities and public sector organizations to private sector firms.

RATIONALE: Research organizations become, over time, significant reservoirs of technologies that have potential commercial application. Too often, however, promising technologies get buried within these organizations.

Communities can help entrepreneurs exploit the fruits of research expenditures and increase the flow of innovations into local industry. Communities can also play useful roles by making it easier for local institutions to access outside technologies.

POSSIBLE COMMUNITY ACTION:

- Make sure that every knowledge-producing institution has a technology transfer office or its equivalent.
- Publicize technology transfer opportunities.
- Encourage cooperative R&D initiatives.
- Consider establishing research parks to create better contacts between local industry and research organizations.
- Strengthen the local IRAP network and technology referrals through the NRC's Canadian Institute for Scientific and Technical Information (CISTI).
- Increase technology in-flow by expanding the role of economic development commissioners.
- Encourage the establishment of private technology brokerage services within the community.

CHAPTER 4
Growing Advanced-Technology Companies

GOAL: To nurture a community base of advanced-technology companies and build them into internationally competitive firms.

Encouraging technological entrepreneurship and increasing the rate of emergence and eventual success of advanced-technology firms are important goals. Communities can pursue them through a variety of means.

Some key areas for local initiative are in:

- Finding ways to increase the financing available within the community for R&D, early-stage firms and growth companies.
- Providing management support within the community, particularly for early-stage firms.
- Making sure that appropriate technical and market support services are available in the community.

A. Financing Advanced-Technology Enterprise

OBJECTIVE: To ensure a steady increase in the volume of locally generated funds available for investment in community-based, technology-intensive firms.

RATIONALE: Canada has a weak record in financing advanced-technology enterprise. Venture capital is abundant, but venture capital investment in technology companies has declined over the past few years.

Advanced-technology firms often have a perpetual cash flow problem. These firms evolve through successive stages of growth. For the first two to five years, new technology-based firms are frequently pure research companies, financed by individuals. Once established, they must annually reinvest a high percentage of gross earnings into their R&D activity. Six to 15 per cent reinvestment rates are typical. At the same time, they must also find resources to extend their market development efforts into the international arena. Consequently, they often require large infusions of new funding relative to their existing sales levels.

Canadian banks do not invest substantially in risk ventures. The venture capital community has its sights set too high to support small enterprises, even those that are likely to develop new technologies. In short, too few Canadians invest in local industry, particularly technology-intensive industry.

The presence of venture capitalists sympathetic to early-stage ventures is critical if a community is going to have any success at gearing up its technology engine. Because the investment of local savings in local advanced-technology companies is so important, communities should actively develop local investment pools in cooperation with all interested players.

Several Canadian communities have successfully organized private sector pools of investment capital. Saskatoon, for example, was able to create a strong venture capital fund to help early-stage technology companies. There may also be a role for individual brokers to become involved in technology venturing. Brokers act as a bridge between start-up firms, sources of capital and markets.

POSSIBLE COMMUNITY ACTION:

- Form venture capital clubs or create local technology venturing networks to encourage potential investors to collaborate in the establishment of community-based venture capital funds.
- Launch a service to help entrepreneurs identify and contact potential investors, such as the Canadian Opportunities Investment Network (COIN).
- Encourage the establishment of a national technology venturing database (see box).

Possible Elements of a National Technology Venturing Database

- Lists of sources of investment capital and expressions of need by companies looking for capital.

Note: The COIN system, now nationwide, includes two types of data and provides for confidential screening of sources of capital as well as investment opportunities.

- Lists of available technology brokers who are skilled in helping small firms manage the interface with the financial community.
- Lists of support services and programs for technological entrepreneurs and early-stage companies.

B. Nurturing Growth: Management Support for Early-Stage Companies and Entrepreneurs

OBJECTIVE: To mobilize community resources to help address the management needs of early-stage technology firms.

RATIONALE: Early-stage technology firms are frequently the brainchild of individual entrepreneurs. Although their role is of pivotal importance, most entrepreneurs tend to have little experience in the management of start-up companies. They tend also to have a technology, rather than a market, orientation.

Community efforts to nurture an advanced-technology industry base depend on more than local R&D activity and technology transfer mechanisms. Managerial weakness, as opposed to a lack of technological capability, is the downfall of many otherwise promising young firms. Nurturing these companies through the early growth stages requires a broad spectrum of support services. Young companies must quickly learn how to manage research programs, finances, and strategic market development.

Community initiatives can provide a variety of services to improve the management of early-stage technology companies. Some services, such as entrepreneur clubs, require only informal organization. They serve as forums where experienced business people share useful information with early-stage technology entrepreneurs.

Several Canadian communities provide formal management services to new technology companies. Incubators and training programs are the types of services most frequently provided.

POSSIBLE COMMUNITY ACTION:

- Foster young entrepreneurs through entrepreneurship and management training.
- Consider forming entrepreneurs' clubs.
- Create networks where experienced business people can share management expertise with early-stage companies, as in the City of Hamilton's "Business Helping Business" initiative.
- Encourage local groups to offer targeted management training programs.
- Consider establishing community-based incubation centres.

C. Advanced-Technology Support Infrastructure

OBJECTIVE: To build up the specialized infrastructure and support services required to attract and support advanced-technology industry.

RATIONALE: Both hard and soft infrastructure are important to the ability of communities to attract and retain innovative people and companies.

Traditionally, community planning has focused on developing the hard infrastructure necessary for economic development. Hard infrastructure refers to roads, communications, industrial parks, water supply, airports, etc. These are, of course, important considerations, but they do not address the highly specialized infrastructure needs of advanced-technology companies — namely, for soft infrastructure, including professional accounting, marketing and design services. Soft-infrastructure also includes banks that are willing to work with technology firms — especially early-stage entrepreneurial companies — and specialized packaging services, prototypers, and transportation companies.

POSSIBLE COMMUNITY ACTION:

- Survey the requirements of local advanced-technology industry for specialized infrastructure and support services.
- Devise specific action plans to redress community shortfalls.

D. Market Development

OBJECTIVE: To strengthen the market development efforts of local firms.

RATIONALE: Local markets are important to some early-stage companies. Depending on the structure of local economies, communities can help develop local markets for advanced-technology goods and services.

In the long run, however, few technology-intensive companies can survive solely on sales within the domestic market. Consequently, the ability of firms to acquire and use market intelligence is crucial. Firms need to position themselves in relation to internationally-changing patterns of consumer demand. Knowledge of the strengths and weaknesses of competitors is of paramount importance. In this respect, our advanced-technology industries are at a competitive disadvantage compared with larger international companies. Canada's advanced-technology sector relies on small and medium-sized firms. Larger international firms have the resources to cull and interpret market intelligence from around the world.

POSSIBLE COMMUNITY ACTION:

- Promote the local procurement of scientific, technical and professional services by large local firms and government organizations.
- Encourage the establishment of a national market intelligence network delivered to local industry through local institutions.

CHAPTER 5

Applying and Using Technology to Build Competitive Strength

GOAL: To create a climate and provide services that will enable firms in all sectors to improve their ability to select and use technology competitively.

Creative communities are not just those that produce technological innovations. They are also those whose industries are effective users of innovation. Indeed, for most communities, local industry's ability to select and use technology is more important than its ability to create technology.

Communities can do many things to accelerate the diffusion of technology. They can help raise corporate awareness of the role of technology in shaping competitive strength. They can help motivate companies to acquire and use technology effectively, particularly by emphasizing the role of technology champions within firms. They can assist companies in the evaluation of specific technological options and sources of supply. They can also help companies upgrade their technology-management skills and adjust to specific technology applications.

A. Executive and Management Awareness

OBJECTIVE: To increase technological awareness within the local business community and to encourage firms to introduce technological innovations.

RATIONALE: Canada lags behind other countries in the rate of adoption of advanced production technologies and management tools. Fewer than 3 per cent of Canadian firms invest in R&D and most have no in-house engineering or scientific capability. The result is a low level of technological awareness.

Most Canadian firms have limited ability to make independent evaluations of technology trends and to manage the innovation process. Corporate success in achieving significant levels of technological innovation depends on a company's ability to evaluate technology trends and to manage the innovation process. In addition, success frequently depends on the presence of a senior champion who provides the motivation for change.

POSSIBLE COMMUNITY ACTION:

- Identify companies in the community that are innovative users of technology. Identify the champions within these companies as well.
- Publicly recognize corporate achievements and technology champions through community awards, honorary distinctions, etc.
- Involve the champions in workshops, seminars and company visits.
- Arrange plant tours to expose local business people to technological or organizational innovations in other firms or industrial sectors.
- Draw on the knowledge available within a community's advanced-technology sector to communicate information on trends to other businesses. This can take place through seminars, for example.

B. Evaluating Company-Specific Technology Needs

OBJECTIVE: To help companies assess the benefits of technological innovation, and help them design and evaluate specific technological options.

RATIONALE: The successful development and application of technologies to increase product quality and cost competitiveness depend on a company's ability to innovate.

Cost accounting techniques often do not reflect qualitative reasons for innovating. For example, a company may innovate in order to meet customers' demands for improved product quality or reliability. Or a company may focus on corporate effectiveness, as opposed to more easily identifiable cost savings.

Most companies rely on information provided by suppliers or consultants when making technology investment decisions. However, many companies lack the skills to assess suppliers' recommendations or to profit from the knowledge of consultants.

POSSIBLE COMMUNITY ACTION:

- Create a network of technology advisors to help small and medium-sized firms evaluate their technology needs. Possible advisors include technology managers from leading firms in the region. The City of Hamilton has taken initiatives in this area.
- Establish regional research centres supported by leading firms.

C. Developing and Accessing Technology

OBJECTIVE: To help local companies develop or gain access to technology.

RATIONALE: The links between local users of new technologies and a community's R&D infrastructure are important. Just as important are the links between local users and the advanced-technology industry (i.e., the suppliers of technology).

Technical services that help small companies develop and access technology include the NRC's IRAP network, technology brokerage programs, the federal government's Technology Inflow Program, and numerous private brokerage services.

These programs are often underutilized because companies are either unaware of their existence or do not understand what the services can do for them. In addition, many firms do not know how to access the programs. Although it is unclear whether new programs and services are necessary, there is a definite need to integrate the delivery of existing programs more effectively.

POSSIBLE COMMUNITY ACTION:

- Forge strong links between potential users of technology, the community's R&D infrastructure and advanced-technology sectors.
- Create a single community point of entry into all programs that target technology development or access.
- In keeping with the above concept, help form a "National Technology Information Network." This network would provide a rapid electronic search capability of available technology services and suppliers. The network could also include an inventory of training courses. In short, it could help companies identify the resources they need to adjust to technological advance (see box).

Possible Elements of a National Technology Information Network

Concept: Expand on the existing CISTI program run by NRC by adding the following elements:

- Lists of services and programs available through governments to assist with the search for technology.
- Lists of technology brokers across the country who are skilled in technology searches.

Note: This database might also usefully identify training courses and programs designed to assist companies in the application and use of technology. (E.g., the inventory of training programs established by the Ontario Training Corporation might be extended into a national system.)

D. Education and Training

OBJECTIVE: To make appropriate educational and training services available.

RATIONALE: Appropriately qualified individuals are crucial to the success of technology-diffusion initiatives.

The successful transition to a more competitive economy is a people-intensive process.

The knowledge and skills of individual Canadians will drive the process. More emphasis must be placed on educating our youth if they are to participate fully in the high-tech global economy.

Consider:

- More than one in five Canadians is functionally illiterate.
- Enrollment in university science and technology programs has levelled off in many parts of the country.
- The gulf between business and education in Canada hinders our evolution towards a technology-intensive society. In particular, the career guidance system in our schools needs adjustment.
- A lack of practical work experience hinders the integration of new graduates into the workforce and, for some, limits their success in finding suitable employment.
- Not enough of our brightest young people are entering the fields on which Canada's future prosperity depends.
- Nor are we paying enough attention to keeping the labour force competitively skilled in the face of persistent change. Private sector investment in knowledge and skills upgrading is inadequate. About 75 per cent of industrial establishments in Canada provide little or no formal training of any kind. By comparison, the Japanese devote from 3 to 20 times as many hours per year to in-service training as we do in Canada.
- Increasingly, scientific and technical workers will also require access to refresher courses. The useful life expectancy of knowledge gained in university is shrinking. Within four years of graduation an engineer's knowledge loses its cutting edge. Yet individuals are severely constrained in their ability to pursue knowledge and skill upgrading on their own initiative. Often they do not have the financial resources to support themselves and their family while on extended training leave.
- It is imperative that science and technology-oriented professionals be given more opportunities to upgrade their education. There is also a compelling need to provide other workers with better training opportunities. We must supplement in-house training by enhancing the opportunities for retraining and knowledge upgrading outside the workplace.

In sum, Canada is not adequately creating or sustaining the human resource base on which the nation's future economic strength will depend. Resolution of this problem requires that communities across Canada take action to raise the profile of science, technology and entrepreneurship within the educational system. Furthermore, we must invest more in upgrading the knowledge and skill base of the Canadian workforce.

The federal and provincial governments have major responsibilities with respect to education and training. Nevertheless, communities can themselves take on many initiatives. Municipalities can encourage local educational institutions to accommodate the technical needs of industry through co-op programs, extension courses, seminars and short courses.

Resolving these issues will require sustained effort. Our aim here is to identify several immediate initiatives that begin to alleviate the situation. These initiatives will require collaboration, chiefly between communities and provincial governments. National business associations have a key role to play as well.

POSSIBLE COMMUNITY ACTION:

- Raise the profile of science, technology and entrepreneurship in curricula and course materials at the primary and secondary school levels.
- School boards should ensure that guidance counsellors are aware of private sector career options for graduates.
- Employers should explore more effective ways of attracting attention to scientific and technical careers.
- Business and educational leaders at all levels should explore ways of strengthening links.
- Expand programs that ease the transition of students to the workplace, particularly at the post-secondary level.
- Companies should provide training and retraining opportunities for their own long-term benefit.
- Every community should have an education and training committee which periodically reviews the needs of local industry for specialized training and knowledge upgrading courses.

CHAPTER 6

Pulling Together: Action for National and Regional Players

We face a daunting challenge in our efforts to gear up the technology engine. Canada lacks the scientific and technological intensity of the world's leading technological nations. Comparisons with global technology leaders indicate we are not investing enough in S&T. We employ approximately half as many scientists and engineers per capita as do our competitors. Our R&D effort and our advanced-technology industry base are both roughly half the size they need to be if we are to compete effectively.

Moreover, what few science and technology resources we have are distributed unevenly across the country. Some communities and regions are better endowed than others. Many are just awakening to the realization that ability to innovate is the key to competitive advantage.

In our market economy and democratic political system, different solutions to the problem of how to enhance technological competitiveness tend to emerge in different regions of the country. Tension will undoubtedly persist between two opposing ways of thinking about technology and community development. One seeks to concentrate scientific and technological strength to create critical mass. In many cases, market forces and existing patterns of investment act to enhance technological capability in regions where it already exists. The other, equally valid, desire is to distribute national capability more equally across the country to increase opportunities for wealth and job creation in less prosperous regions. The way we resolve this debate will have an important influence on the evolution of the Canadian economy.

In previous chapters, it was proposed that communities cooperate with one another to strengthen their ability to select, generate and apply technology for business development.

It was further proposed that community efforts be complemented by links between major technological centres and outlying users. Communities must also have access to national scientific and industrial development resources, and to international science and technology networks and markets.

Consequently, there is a pressing need to develop national support networks. What communities cannot accomplish alone, they may achieve by pulling together. The goal must be to foster the development of a national innovation system. This system must effectively reach out into the entire business community from one end of the country to the other. The national innovation system must encourage local initiatives that help communities build on their strengths. It must help unite community resources and effort in a common cause.

This chapter suggests ways in which the country, the regions and the provinces can take action to complement and encourage communities' efforts to generate and apply technology for business development.

The key players are national or regional business associations and the federal and provincial governments. Some of the proposed initiatives can be taken by the private sector acting alone. Others lend themselves to private-public partnerships. For the remaining initiatives, government can wield the necessary policy instruments.

It should be added that our ultimate ability to engage in and benefit from the initiatives suggested in this report requires that we forthrightly address our national deficit spending and accumulated debt. In that respect, the initiatives proposed here should be undertaken in a spirit of fiscal responsibility. That is, efforts should first of all aim at spending smarter.

A. Education, Training and Skill Upgrading Needs of the Knowledge-Based Economy

Previous chapters emphasized that Canada is not adequately creating or maintaining the human resource skills on which the nation's future economic strength will depend.

Resolution of this problem requires that governments, in collaboration with stakeholders from communities across Canada, take action to raise the profile of science, technology and entrepreneurship within the educational system, and to invest more in upgrading the knowledge and skill base of the Canadian workforce.

Many public programs that support training and retraining courses are currently available. However, they are scattered throughout various levels and agencies of government. Resources could be used more effectively if there were greater integration of programs. Communication of the existence of programs needs to be improved, and access requirements simplified.

The business community must increase its support of educational and training programs as a matter of philosophy and good business practice. Business associations should focus attention on what they and their members can do to improve investment in knowledge and skills upgrading. Cost sharing arrangements with the public sector could also be examined.

Individuals are often interested in upgrading their skills, but have no direct access to programs and are unable to pursue retraining opportunities without additional resources.

Existing programs should be adjusted to allow access directly by individuals when access is not possible through their employer.

POSSIBLE ACTION:

- Companies should incorporate training and retraining opportunities into their corporate culture.
- Governments and business associations should collaborate to create programs which provide individuals with flexible means to pursue skills upgrading.
- Governments should increase their efforts to integrate existing programs that support training, simplify administrative requirements and increase promotional efforts.
- Business associations should encourage their members to expand training and retraining efforts as a matter of good business practice.
- Business associations should address the education and training needs of workers and propose concrete initiatives, such as the preparation of course materials, support of programs or chairs, provision of scholarships, or expansion of work-study opportunities.

B. Enhancing the Climate for Innovation

The Investment Climate

A community's ability to create local pools of capital for investment in R&D, start-up or expansion by local technology firms depends in large part on the national policy climate. Senior governments influence this climate through incentives and programs. Private investors influence this climate through their investment decisions, which reflect their attitudes and expectations.

Successful cultivation of a new generation of small firms depends on the availability of investment capital. Canadian capital markets do not provide the necessary investments in technology-based firms. Instead, funding comes primarily from individuals, such as the owner/entrepreneur, friends, or members of the underground venture capital industry ("angels").

Threshold firms present an additional set of challenges. Advanced-technology firms are often cash poor. They must re-invest a high proportion of earnings in R&D and simultaneously bear international marketing costs. As these firms move through successive growth stages, many reach thresholds where financing requirements are quite high in relation to sales. These firms may have excellent technology and sound market prospects. However, they are not attractive investments according to conventional calculations.

Investment incentives that will most help early-stage companies are those that lessen the risk for individual investors. For early-stage companies, the most effective tax incentive would be an efficiently administered R&D tax credit that flows through to the individual investor.

POSSIBLE ACTION:

- Roundtable participants were unable to agree on how to increase investments in Canadian technology-based firms. Some participants advocated having Revenue Canada modify its administrative practices so as to improve capital flows to start-up firms. Others suggested strengthening R&D incentives. For threshold firms, some participants recommended that governments provide cost-shared financing on a cost-recovery basis. Others proposed a public Capital Assistance Fund that would make equity investments in Canadian threshold firms. Still others preferred minimal public sector involvement.

Support for the Market Development Efforts of Advanced-Technology Companies

Canada's high proportion of small firms constrains the growth prospects of its advanced-technology sector. Economies of scale give larger firms and agglomerations of companies the advantage when marketing high-tech goods and services internationally.

National and regional governments and business associations can assist the market development efforts of small firms. One initiative they could take is the establishment of a national market intelligence network. There is also much to be done in the area of government procurement.

i) Government Procurement Policies

Government procurement could be a significant catalyst in the development of technology-based firms, whose ability to compete in international markets is enhanced by supportive national markets. However, the amount of procurement in Canada lags well behind that of competitor nations. Termination of the federal government's relatively small but successful Unsolicited Proposal Fund eliminated the only mechanism which provided support for private sector innovators of government technical services.

Current procurement practices treat small and large firms identically. This contrasts sharply with the situation in the United States. There, smaller companies benefit significantly from two programs: the Small Business Set Aside Program (SBSA) which reserves a fixed portion of total government procurement for small companies, while the Small Business Industrial Research Program (SBIR) requires federal agencies to reserve a percentage of their R&D budgets for small private sector firms.

Government agencies develop an enormous amount of technology in-house. The development of such technologies cannot be justified by the intent to transfer them later to industry. Industrial technology development is best carried out by industry in a market environment. More aggressive efforts to transfer such technologies to private firms would contribute to the growth of Canada's advanced-technology industry base. Also, restrictive policies with respect to intellectual property developed with public assistance act as a disincentive to many firms and should be reviewed.

POSSIBLE ACTION:

- Governments should implement policies to increase the contracting out of departmental R&D requirements.
- The federal government should re-establish the Unsolicited Proposal program. Furthermore, national and provincial governments should establish technology incubation funds which would be used to support private sector contract research for program delivery purposes. The funds would provide support for technological development through the demonstration stage in public sector environments. Ownership of intellectual property would reside with the contracting company.
- The federal government should consider creating a procurement "watchdog office", possibly within Industry, Science and Technology Canada or the Treasury Board, to coordinate public sector efforts, develop measures to maximize value-for-money, and monitor results regarding contracting out policies.
- Senior governments should introduce Canadian versions of the SBSA and SBIR programs.
- Senior governments should establish more aggressive programs to transfer in-house technologies to the private sector.

ii) Market Development

If Canada is to be an effective trading nation in the new international economy, Canadian firms must become more international in outlook. The market development strengths of individual companies will be critical. Firms should always regard the assessment of market opportunities as an integral part of developing new products.

Characteristics of a National Market Intelligence Network

- Industry-driven, flexible and "open"
- Capable of timely delivery of intelligence
- User- or company-oriented
- Electronically accessible and interactive

The starting point is the rapid and effective search for data through existing databases, both national and international.

Over time, the system might become more proactive in the sense that improved government capability to search the globe for sector-specific market intelligence might be encouraged, with market intelligence then being electronically distributed to predetermined companies across the country.

Source: The 1988 National Technology Policy Roundtable on "Market Development" organized by the Canadian Advanced Technology Association. Toronto, September 26-27, 1988.

A higher level of investment in market development activity must be encouraged within our internationally-traded goods and services sectors. The volume, quality and accessibility of market information must also be increased. Governments can further these goals through collaborations with national trade associations.

POSSIBLE ACTION:

- National business associations, in concert with governments, should consider establishing a national market intelligence network to assist Canadian firms in carrying out required market analysis (see box, page 35).

C. Encouraging the Application and Use of Technology

Most smaller firms encounter difficulties when learning how to use technology to improve their competitive position. Managers can raise funds for technological innovation once they understand clearly the need for the technologies and the costs and benefits associated with development and introduction. However, most companies find it extremely difficult to assess technology. They lack the necessary scientific, engineering or technology resources to do the job properly.

Government cost-shared programs such as the Industrial Research Assistance Program (IRAP) have been successful in helping smaller firms acquire technological information and assess the merits of specific innovation options.

POSSIBLE ACTION:

- Consider establishing a National Technology Information Network as discussed in Chapter 5.
- Reallocate existing funds to support the IRAP program and maintain its efficient administrative procedures.

D. Regional Development Policies

In the emerging information economy, a country's most important resources are its people. The key to knowledge-based economic growth resides in the education, training, and cultivation of appropriately-skilled citizens. Investing in people is a good starting point for regional development efforts.

A second step is to build on local strengths. This means creating a community environment that welcomes advanced technology industries and industrial innovation. Technology engines should not be imported. Nor should senior governments incite leading companies to move portions of their operations to slow-growth regions. This only erodes existing areas of scientific and technological strength. The country cannot afford to fragment effort in this manner. Self-help should be the operational principle underpinning regional development policies.

POSSIBLE ACTION:

- In designing regional development strategies, governments should aim to build on local strengths. Policies should aim to enlarge community access to knowledge and economic opportunity through networking and community outreach activities.

E. The Communications Infrastructure of the Information Age

Advances in communications technologies will create new opportunities in Canada. In particular they will allow communities to cooperate more readily. Networking can help reduce some of the problems of isolation and small scale that many Canadian communities face.

Access to information, the ability to select relevant information and the ability to absorb it are crucial elements of today's business environment.

Access to information networks is crucial. Communications infrastructure and networks will be to the 21st century what railways were to the 19th. Information autoroutes will be national in scope, but permit close association between regional actors, both private and public. The Vision 2000 program launched by the Department of Communications offers promise in this regard.

Industry associations are beginning to recognize what communications technologies can offer their members. The Canadian Chamber of Commerce's Focus 2000 initiative includes the establishment of ChamberNet, an electronic communication network and database which provides business information to members.

Where business is unable to establish networks, government may take the initiative. The Newfoundland and Labrador Development Corporation is considering establishing an

The "Vision 2000" Concept

Mission: to establish by the end of the century an affordable and internationally competitive communications capability that will allow all Canadians regardless of location to send and receive images and information.

Network Characteristics

- It is ubiquitous — it can connect to every house, desktop and classroom.
- The terminal devices are intelligent and offer extreme simplicity of use for basic functions. Optional capabilities and devices can be added.
- It is a two-way network.
- It has very wide band width, capable of full video and image handling.
- The main backbone is potentially capable of ultra-high band width.
- The network is "seamless" to the user. Whatever mix of physical facilities it needs are submerged below the consistent user interface.

Initial definition of a research project resulting from "Search 20 - A Canadian Communications Research and Development Forum" sponsored by Communications Canada. St. Sauveur, Quebec. May, 1989.

Enterprise Network which will include windows for direct access to over 1000 databases, an information technology transfer program and the development of a variety of databases. Quebec, Manitoba and Alberta already have similar networks in place.

The development of a national communications infrastructure will require the close cooperation of both industry and the two senior levels of government. Such an infrastructure will allow individuals, companies and communities instantly to access voice, data or images and to join forces with anyone else in the country.

Such an infrastructure is now in the early stages of conception (see box, page 37).

POSSIBLE ACTION:

- Governments and business associations should take a leadership role in creating the national user networks communities need to gear up the technology engine.
- Canada should mount a major long-term national project to develop and install leading-edge communications infrastructure.

F. Sustaining Political Commitment: The Management of Change

We must work to create and sustain a nationally-shared vision about the role of science and technology in economic growth. The proposals contained in this report will be effective only if communities across the country accept the need to gear up the technology engine.

Initiatives to support community actions will require a high level of sustained political commitment. This requirement, in turn, creates a need for new forms of political interaction and dialogue within the Canadian political system.

POSSIBLE ACTION:

- The issues raised in this report should be tabled at the annual meeting of first ministers for review and approval as guiding principles for Canada's S&T strategy.
- All Canadian communities and trade associations should consider organizing workshops or conferences to discuss the issues raised in this report and to devise action plans.
- Senior governments should prepare an action plan designed to support community initiatives. The action plan should reflect the proposals put forward here.
- Project groups should be struck to oversee the development and implementation of the national plan, and to provide encouragement and support to participating communities.

CHAPTER 7
Conclusion

Canadians are in direct competition with communities, businesses and workers around the world. We must find ways to build on our traditional economic strengths, and we must develop our innovative capabilities in order to respond quickly to new opportunities. The challenge of competing in a global economy is on our doorstep.

Marshalled effectively, technology can be the key to competing successfully in a global economy. Technology is an integral part of running a business today. Using technology more effectively means enhancing business opportunities and increasing profit potential.

Community commitment and community action will be essential to meet this challenge. National goals can be achieved only through concerted efforts starting at the community level. This will require individual business initiative, community leaders with a vision of the future and the coordination of support networks: in short, a coming together of the principal players to enhance the strengths of a community.

The 1989 National Technology Policy Roundtable brought together leading business, education, and government spokespersons from across Canada. They compared notes about development initiatives in their communities and provided the guidelines set out in this report.

The 1989 National Technology Policy Roundtable called on community leaders across Canada to raise these issues within their communities:

- How well prepared is the community to adopt science and technology?
- What are the community's strengths and weaknesses in science and technology?
- What technology engine components are in place, and what can be done to improve them?
- What are community leaders willing to do to develop vision and culture, to build and use the local knowledge base, to promote the growth of advanced technology companies and to enhance the application and use of technology in the community?

This report has outlined the competitive challenges facing Canada. Challenges that can be successfully met through concerted action at the community level.

If you are a leader in your community, the next step is yours.